NASA PLANETARY ASTRONOMY PROGRAM

GRANT NAGW-1461

CCD PHOTOMETRY OF TROJAN ASTEROIDS

FINAL REPORT

Linda M. French, Principal Investigator
Air Force Geophysics Laboratory and Lowell Observatory
Current Position: Head, Science Department, The Park School, Brookline, MA

ORIGINAL WORK PLAN AND REVISIONS

A. Rotation Properties of Trojan Asteroids

Our original goal was acquisition of the lightcurve period and amplitude of 6-10 Trojan asteroids. During the lightcurve observing runs listed in Appendix A, we had no photometric weather and were completely clouded out more than 50% of the time. We were able to obtain relative lightcurve data on three Trojans: 884 Priamus, 2893 Peiroos, and 2797 Teucer. Since the PI's publications during the time of this grant have involved absolute photometry, publication of these lightcurves is being withheld until an appropriate larger number of lightcurves is available. Other observing runs under other funding are planned for CTIO in March and Lowell in June.

B. Phase Curves

The acquisition of another Trojan phase curve is perhaps the most pressing goal of this project. Unfortunately, photometric weather over a number of nights is required, and thus we have not been able to get phase curve data. In our proposal we described coordinated observations with Larry Lebofsky at the IRTF in order to study the simultaneous visible and infrared lightcurves; Dr. Lebofsky did not get the observing time and so these observations were not possible. The upcoming March CTIO run has been planned so that four Trojans are near zero phase and go through a wide range of phase angle during the observing run.

C. New Research Initiated Under this Grant

While Schelte J. (Bobby) Bus was in Chile observing lightcurves of the L5 Trojan group in 1988 and 1989, we also obtained dark time on the CTIO--Univ. of Michigan Curtis Schmidt Telescope to conduct a search for new L5 Trojans. Our efforts were coordinated with those of E. Bowell and K. Russell, who used the UK Schmidt telescope, and E. and C. Shoemaker, who used the Palomar 18" Schmidt. In our project ten fields were studied, centered on the center of the known L5 group, but extending to high ecliptic latitude and longitude. The wide angle coverage is necessary, as Trojans are known to have orbital inclinations as high as 33° and there is no theoretical upper limit to their libration amplitudes. Our initial survey included three plates in each of two months, enabling us to identify the 37 new objects from night to night and to calculate provisional orbits. They were then reacquired in 1989; the new orbits are of sufficient quality for permanent numbers and names to be assigned. Preliminary results of the search were presented at the Asteroids, Meteorites, Comets III meeting in Uppsala, Sweden, in 1989 and published in the abstract book from that meeting. These orbits have been published in the *Minor Planet Circulars*; a final manuscript describing the coordinated Trojan search will be prepared when the other collaborators have completed their reductions. In addition, 171 new non-Trojan asteroids were discovered and followed up in the survey; orbits for these asteroids have been prepared by Bowell and Bus and published in the *Minor Planet Circulars*.

PUBLICATIONS SPONSORED BY THIS GRANT

1989

French, L. M., and R. P. Binzel. CCD photometry of asteroids. Invited review in *Asteroids II*, R. P. Binzel, M. S. Matthews, and T. Gehrels, eds. University of Arizona Press, Tucson.

French, L. M., F. Vilas. W. K. Hartmann, and D. Tholen. Distant asteroids and Chiron. Invited review in *Asteroids II*, R. P. Binzel, M. S. Matthews, and T. Gehrels, eds. University of Arizona Press, Tucson.

Shoemaker, E. M., E. Bowell, S. J. Bus, L. M. French, K. Russell, and C. Shoemaker. A Search for Trojan asteroids in the L5 region. In *Comets, Meteorites, Asteroids III*, proceedings of conference held in Uppsala Sweden, June, 1989.

[Asteroid observations I.] by L. M. French *et al.* In *Minor Planet Circulars* 15332-15364. Published by the Minor Planet Center at the Smithsonian Astrophysical Observatory.

[Asteroid observations II.] by L. M. French *et al.* In *Minor Planet Circulars* 15506-15507.

1990

[Asteroid observations III.] by E. Bowell *et al.* In *Minor Planet Circulars* 15631-15635.

[Asteroid observations IV.] by E. Bowell *et al.* In *Minor Planet Circulars* 15827-15832.

APPENDIX A. LIGHTCURVE OBSERVING RUNS

Date	Telescope	Results
September 1988	CTIO 0.9-m	Relative lightcurves of 884 Priamus and 2893 Peiroos.
December 1988	Lowell 1.8-m	Relative lightcurve of 2797 Teucer for one night before weather and equipment problems.
October 1989	CTIO 1.5-m	(Time not granted)

APPENDIX B. TROJAN SEARCH OBSERVING RUNS

Date	Telescope	Results
October 1988	CTIO Schmidt	Discovery of 37 new L5 Trojans and provisional orbit determination
November 1989	CTIO Schmidt	Recovery of previously discovered 37 Trojans for determination of high quality orbits.